wonders of the universe; but, nevertheless, we may be full of hope for the future. Step by step we gain in knowledge, and with each step we acquire better opportunity for improving the lot of mankind, and for illuminating the dark places in our philosophy of nature. Although we shall none of us live to see the full development of the help which science may render to the world, we rejoice in the belief that chemistry has boundless service still in reserve for the good of the human race.

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THE ONE HUNDREDTH ANNIVERSARY OF THE U. S. COAST AND GEODETIC SURVEY[1]

THE honor of being one of the speakers on this memorable occasion is highly appreciated, in spite of a perfect realization of the fact that it comes to me solely because I have had the fortune, good or bad, to survive my predecessors. To live long, according to a well-known proverb, is to prove that one is not a favorite of the gods; on the other hand, to live long is to furnish fairly good evidence that one has not been found guilty of a capital crime.

During the past two days the various activities of this service have been so thoroughly discussed by competent critics that there is little room for further comment. As I am, in a way, representing the men who directed these activities during the century of its existence, I choose to speak, not for them, but of them, the superintendents of the Coast and Geodetic Survey, with some reference to their share in the development of the work.

To the republic of Switzerland American science is enormously indebted. Thence came Agassiz, Guyot, Lesquereux, and others who stirred us into scientific activity fifty years ago, and more than a half century earlier came Ferdinand Hassler, organizer and first superintendent of the Coast Survey. No brief sketch can do justice to Hassler's personality or to his all-powerful influence in molding the character of the new organization, the first of the so-called "scientific bureaus" of the United States government. Educated in the best schools of Europe, intimately acquainted with the most eminent scientific men of the Old World and with experience in the trigonometrical survey of his native country, he possessed exactly the qualifications necessary to a successful launching of the new enterprise. Not the least of these qualifications was one rather rare among men of science, though common enough in the so-called "learned professions." With intellectual power and technical skill of the highest order he combined an equally high appreciation of his own merits. It is related that when invited to organize and direct the survey of the coasts, which had been strongly recommended to Congress by Thomas Jefferson, he demanded and received a salary equal to that of the head of the department to which the new bureau was assigned. *Tempora mutantur!* There is also a tradition that when the President objected, saying, "Your salary is as large as that of my Secretary of the Treasury, your superior officer," he replied: "Any president can make a Secretary of the Treasury but only God Almighty can make a Hassler."

Visiting Europe to purchase the necessary instruments and standards of measure, he was detained in England as an alien enemy until 1815 and thus a period of nearly ten years elapsed between its authorization by act of Congress and the actual inception of the Survey.

Hassler's plan of organization, broad and thoroughly worked out, is still the funda-

[1] Address given at the banquet, April 6, 1916.

mental directing ordinance of the Coast Survey. He provided for the division of its operations into three great groups, the geodetic, the topographic and the hydrographic, and of these he considered the geodetic the most important as affecting the accuracy and final value of the results. In insisting upon a degree of precision in the execution of these operations hitherto undreamed of in this part of the world, he "set the pace" which the Survey has since maintained with such distinction and which it must continue to maintain if its future is to be worthy of its past.

Naturally a man of his temperament was likely to come into occasional conflict with government authorities who were quite unable to appreciate the nature and demands of such a service. The very refinement in measure and computation which was the chief merit of the work came near being the undoing of Hassler as it has, indeed, of more than one of his successors. In 1842 a congressional committee made a searching and unfriendly investigation of the Survey, during which, as one of its members confessed on the floor of the House, it was found that of the subject under consideration the superintendent knew so much and the inquisitors so little that the committee was helpless in his hands. Although the work of this committee, like that of most of its successors, was an inquisition rather than an investigation, its report was practically a complete endorsement of the principles on which the Survey had been conducted by Hassler. His death occurred in the following year, but not before a complete and comprehensive plan for the continuation and expansion of the work had been outlined and approved by Congress.

The duty of executing this plan, of building upon the foundation laid by Hassler, fell to one who was everywhere acclaimed as the best fitted for the task.

Alexander Dallas Bache had inherited through his grandmother, the famous "Sally Bache" of the Revolutionary period, only daughter of Benjamin Franklin, not only his distinguished ancestor's tastes for scientific pursuits, but also much of his tact and skill as a diplomat, a quality that contributed in no small degree to his notable success as superintendent. After graduating from West Point Military Academy at the age of eighteen years, at the head of his class, with the extremely rare record of having completed the entire course without having received a single demerit, he had enjoyed a wide experience in public service in various capacities, besides being actively engaged in important researches in magnetism and electricity.

At the age of thirty-seven years he had already won distinction as a scientific man of originality and power and his appointment as Hassler's successor was recommended by all of the principal scientific societies and institutions of learning in the country. His service extended over a period of almost exactly a quarter of a century, being terminated by his death in 1867. The splendid superstructure which Bache erected upon Hassler's foundation has received the highest praise from competent judges in all parts of the world.

During his administration he was successful in securing the confidence of Congress and the operations of the Survey were greatly extended. While keeping well in mind the practical results, for the attainment of which the organization was created, he had a keen eye for the purely scientific by-products of which he gathered a great harvest. The distinguished mathematician and astronomer, Professor Benjamin Peirce, on assuming office as his successor, said of the Coast Survey at the end of its first half century: "What it is Bache has made it. It will never cease to be the admiration of the scientific world. It is only necessary conscientiously and faith-

fully to follow in his footsteps, imitate his example and develop his plans."

During the later years of Bache's administration Professor Peirce had directed the longitude operations of the Survey, acting also as a sort of general scientific adviser and naturally his policy after becoming superintendent was essentially that of his predecessor. Many of the larger operations of the Coast Survey had been suspended during the Civil War, in which both the superintendent and his assistants had played an important part. The execution of the primary triangulation on both the east and west coasts was resumed by Peirce and an exploration and survey of the newly acquired territory of Alaska was begun. The most important act of his administration was the development of a plan for two gigantic chains of triangles extending across the continent, thus covering the whole country by a trigonometrical survey and joining the systems of the Atlantic and Pacific coasts. This scheme received the approval of Congress and was in many respects the most remarkable work of its kind ever undertaken by any government.

Peirce had continued to hold his professorship in Harvard University and also his many other activities, as a writer of text-books, a frequent contributor to scientific journals, etc., and at the age of sixty-five years, doubtless finding his burden too heavy, resigned the superintendence of the Survey in 1874, after a service of seven years, but he continued to act for a time as "consulting geometer." As a genius in mathematics and astronomy he is easily the star of first magnitude in the Coast Survey galaxy.

Peirce's successor was Carlile Pollock Patterson, naval officer and son of a naval officer.

Previous to his appointment as superintendent he had served for more than a dozen years as hydrographic inspector, an appointment usually held by a naval officer, active or retired.

The general plans of the Survey as perfected by his predecessors were adhered to by Patterson, whose term as superintendent covered a period of seven years, ending with his death in 1881.

His successor, Julius Erasmus Hilgard, was brought at the age of ten years from his birthplace in Germany by his father, a highly educated and successful lawyer and jurist in his own country, who settled on a farm in Illinois near the city of St. Louis. Educated by his father, young Hilgard at the age of eighteen years went to Philadelphia to study to be a civil engineer. There he soon attracted the attention of Professor Bache, who invited him to become one of his assistants in the Coast Survey. In 1845 he joined the corps, his connection with it terminating on his resignation in 1885 after forty years of service. His industry and rare talents brought rapid promotion and in 1862 he became assistant in charge of the office in Washington, a position next in importance and responsibility to that of superintendent. In this capacity he served for nineteen years until his appointment as superintendent in 1881. In the meantime his reputation had become international. He was one of the most influential members of the International Metric Commission that met in Paris in 1872; was made a member of its permanent committee and on the organization of the International Bureau of Weights and Measures, with headquarters at Paris, he was offered the directorship. This honor he declined. By training, ability and experience Hilgard was more completely fitted for the headship of the Coast Survey than any other person who has ever served in that capacity and it was unquestionably the goal which he had hoped to reach.

Recommended for the appointment as Bache had been forty years earlier, by

scientific men, learned societies, colleges and universities, he began his administration under the most favorable conditions. During the earlier years his work justified the confidence reposed in him, but in the meantime, unknown to his friends and perhaps unsuspected by himself, he had become the victim of an insidious disease which weakened the power of both his will and his intellect. Undoubtedly advantage was taken of this fact by others and an investigation of the affairs of the Survey brought to light certain irregularities in its business management that were at first believed to reflect upon the integrity of not only the superintendent, but of many of the older assistants, especially those employed in the field. The superintendent resigned in 1885 and a long and brilliant career thus ended in almost a tragedy.

The investigation referred to was made by a committee of three employees of the Treasury Department with Frank Manley Thorn, chief clerk of internal revenue, as chairman.

Mr. Thorn was placed temporarily in charge of the Survey, and afterwards by appointment of the President he continued to act as superintendent until the close of the first Cleveland administration. The unprejudiced historian can not fail to accord to Mr. Thorn great credit for the way in which he managed the affairs of the Survey during this trying period. Inspired by a prospect of participating in the spoils of office, a number of witnesses had volunteered testimony that was either grossly misleading or absolutely false, and this had been incorporated in the report of the commission of which he was chairman, along with a severe arraignment of the business methods of the Survey and of the integrity of several of its principal officers. During the nearly four years of his administration he learned much about the methods and requirements of such a service as the Coast Survey of which in the beginning he had been totally ignorant. A man of sterling integrity, he had the courage to revise this report by innumerable additions and annotations, practically vindicating the men against whom charges had been made, most of which were merely technical.

In spite of the unwholesome conditions existing in the beginning of Thorn's administration the operations of the Survey were continued without serious interruption and much important work was accomplished.

A much more regrettable state of affairs prevailed during a considerable period of the administration of General William Ward Duffield, who served as superintendent for about three years following his appointment in the autumn of 1894. Not only was the influence of the spoilsman again paramount, but for some unexplainable reason a number of men were dismissed from the force whose places could not be filled from any source whatever. Men of long and faithful service, whose reputation was international, were lost to the Survey at that time, though a few men afterwards were reappointed. It is charitable to assume that the superintendent, who was by profession a civil engineer with a record of good service in the Civil War, had passed the years of discretion before receiving his appointment. That the paralysis by which the service was then afflicted did not become complete was due entirely to an unwavering loyalty to its best traditions on the part of those who remained.

The historian would gladly pass over these unpleasant episodes, but a due regard for the good name and fame of many individuals involved demands brief reference to them.

I come now to the living, whose connection with the service is quite within the memory of most of those interested, and

of whose work little need be said. There are times when brevity is not only the soul of wit but also the essence of discretion.

Upon Henry Smith Pritchett, astronomer and son of an astronomer, fell the task of making a complete reorganization of the hydrographic operations of the Survey. From the earliest days these operations had been carried on almost entirely by naval officers detailed for that purpose, but during the war with Spain such details became impossible. The difficult problem thus presented was solved with marked success by Pritchett and this reorganization, though but one of many notable things accomplished during his comparatively short term from 1897 to 1900, must be regarded, I think, as the most important act of his administration.

The appointment of Otto Hilgard Tittmann, as successor to Pritchett on the resignation of the latter, was an event predetermined by his long connection with the service, which began in 1867, when he was seventeen years old, and continued without interruption for almost a half century, to his resignation in 1915. Inheriting through his mother the scientific tastes and special talents of the Hilgards, with successful experience in nearly every one of the various operations of the Survey, including many years as assistant in charge of the office and assistant superintendent, his remarkable career ended with the longest term as superintendent since the time of Hassler and Bache. Under his direction the Survey has advanced with great strides and so many important things have been accomplished that it is difficult to select even one for mention in this brief review, but among those of first rank will surely be found his personal and official services in representing the United States on numerous international commissions and boundary tribunals.

I am tempted to overstep the bounds laid down for me, to pay my tribute to the ability, faithfulness and loyalty with which the assistants of the superintendent have almost invariably supported him in the discharge of difficult and often disagreeable duties, and I use the term assistant as including not only those employed in the field, but also the office force; the computers, engravers, printers, mechanicians, clerks, etc., through whose hands all of the work of the field officers must pass before it becomes useful to the public. Without this support the ablest chief could accomplish little or nothing. I would like especially to speak of a few of the veterans of my own time who have passed away; of Whiting who, beginning with Hassler, had served for more than a half century and under every superintendent up to the day of his death; of Davidson, the oracle of the Pacific coast, whose service was nearly as long; of Schott, the severe but just judge at the head of the computing division; of Mosman, Fairfield, Eimbeck, Ogden, Grauger, Preston, Mitchell, Smith, Rodgers and others; it is a long roll but it is a roll of honor in the annals of the Survey. To them, and to many others, happily still living, I owe a debt of gratitude for their loyal cooperation and support.

I desire also to testify to the great importance to the service, of the cooperation of the army and navy, especially in the detail of officers from the army in the early days and from the navy during many years for special duty under the superintendent, to whom they were almost, without exception, unselfishly loyal.

I should like, also, to speak more than briefly of some of the famous men who were at various times attached to the Survey for longer or shorter periods, some of whom in this service laid the foundation of their future careers in which they achieved great distinction; of the great artists, Whistler and Alexander; the great scholars, Agassiz

(rather and son), Ferrel, the two Peirces, Gould the astronomer, and others; of Captain Derby, the "John Phœnix" of the world of wit and humor; of Blake, the inventor, and many others, but in this I may not indulge myself.

If I could summon their spirits from the "vasty deep" I am sure those of the former superintendents who are dead would join with those who are living in congratulating their successor who has recently been charged with the responsibility of directing its operations, on the thoroughly trained and competent corps of assistants who will aid him in carrying the Coast and Geodetic Survey into its second century. But perhaps even more important than these will be the traditions of a hundred years which he will not lightly put aside.

I confess to a feeling of *nausea* in these latter days whenever I hear the word *efficiency*, wrenched as it has been from its original meaning and made to stand for "the greatest possible output in the least possible time." The Survey has often been the object of adverse criticism, based on ignorance of the character of its work, because of the slowness of some of its operations. It is to its everlasting credit that as far as known no one has ever found fault with it for not keeping its work up to the highest standard attainable at the time.

Not "how much?" but "how well?" has been its criterion.

It is only by persistently adhering to standards of quality rather than quantity that it will continue to be as it was in the middle, and still is at the end, of its first century, "the admiration of the scientific world."

T. C. Mendenhall
Ravenna, Ohio

GRANTS FOR SCIENTIFIC RESEARCH

MEDICAL SCHOOLS AND LABORATORIES

(*Continued from Vol. XLIII., p. 681*)

The following list contains such facts as the committee has ascertained regarding the funds which are available for medical research in the United States and Canada.

Bender Hygienic Laboratory, Albany, N. Y. Dr. Ellis Kellert, Director. Income, not exceeding $200; available at discretion of Director.

Harvard University Medical School, Boston, Mass. Dr. E. H. Bradford, Dean. Funds approximately "between $350,000 and $375,000" exclusive of teaching fellowships, many of which are utilized for research.

Massachusetts Homeopathic Hospital, Boston, Mass. Dr. F. C. Richardson, Director. Evans Memorial Department of Clinical Research and Preventive Medicine. Income from fund of $260,000 available.

University of Chicago, Chicago, Ill.

Rush Medical College. Dr. J. M. Dodson, Dean. Appropriations from General Budget.

Otho S. A. Sprague Memorial Institute. Dr. H. Gideon Wells, Director. Approximately $35,000 per annum appropriated for research in medicine, used chiefly in paying salaries of research workers.

Memorial Institute for Infectious Diseases, Chicago, Ill. Dr. Ludvig Hektoen, Director. Income from $2,000,000 devoted to research in infectious diseases.

Northwestern University, Chicago, Ill. Dr. C. W. Patterson, Dean.

James A. Patten Fund for Medical Research. $200,000. Income approximately $10,000. Available in all departments of medical research but used mainly in department of bacteriology and in research on tuberculosis.

James A. Patten Fund for scholarships in medical research. $50,000. Income approximately $2,500. Available under same conditions as above.

Vail Research Fund. $2,000. Income available for a research fellowship.

Western Reserve University, Cleveland, Ohio. Dr. C. A. Hamann, Dean.

Cushing Fund. $170,000. (Cushing Laboratory of Experimental Medicine.) Apparatus Fund $17,000. Payne, Crile Fund $8,000. Hanna Fellowship Fund $12,000.

McGill University, Montreal, Canada. Dr. Francis J. Shepherd, Dean. Douglas Research Fellowship in Pathology. $25,000.

Yale University, New Haven, Conn. Dr. George Blumer, Dean. Francis E. Loomis Fund. $20,000. Up to 1915 interest appropriated chiefly for departments of anatomy, physiology and pharmacology.